be possible to supply, augmenting that now received.[5] If it were known in advance that the following day would have a very low vapor pressure, the field force of the Forest Service, upon the occurrence of a fire on that day, could dispatch more men to it than would ordinarily be required for a fire in that particular region. On the other hand, with a knowledge of a greatly increasing vapor pressure it would be possible to take a smaller number of men than in the first case, because climatic conditions would be in favor of easy control. Notification in advance of periods of extreme fire hazard would make it possible to augment the Forest Service force to care for the emergency.

Up to the present it has not been possible for the Weather Bureau to predict the local heat type of thunderstorms. The widespread thunderstorms, which accompany low-pressure areas, can very readily be predicted, but the heat type, being entirely local, has so far not been as carefully studied from the forester's standpoint as we should like. A study of the data from Red Bluff for the period 1911 to 1920, inclusive, shows that when the vapor pressure increases rapidly and reaches a point of about 0.380 inch (Hg.) local thunderstorms occur in the high mountain region. When the vapor pressure rises above 0.420 inch rain occurs with these convectional storms. The difference between these two extremes is the danger period during which we have the "dry lightning" storms, when lightning and thunder occur without rain. These are the most dangerous periods for the forest; during such times a large number of fires start, and as no rain falls they have a chance to spread to large size before they can be reached by the field force.

In going over the vapor-pressure data for the period from 1911 to 1920 it was found that in those years and months when the average monthly vapor pressure remained high a very small number of fires occurred, while in those years and months with a relatively low average monthly vapor pressure there were uniformly periods of extreme hazard and many bad fires occurred. Should it be possible by some system of forecasting, such as that of the Scripps Institute [from ocean temperatures][6] or by the occurrence of sun spots, to determine in advance what a particular month would be like in the way of fire hazard, our protection system could be put on a much more stable and safer basis than at present.

The whole field of the relation of vapor pressure and evaporation to forest fires offers possibilities which certainly have not been considered to any great degree before. It is planned to study evaporation during the present season on the national forests throughout the State, in order that we may determine the danger points and the possibility of their prediction. If such a study could be made nation-wide, a long step forward would be taken in our knowledge of the physical controls of fire.

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FORECASTING THUNDERSTORMS BY MEANS OF STATIC ELECTRICITY.

By FRANCIS W. REICHELDERFER.

[Naval Air Station, Hampton Roads, Va., Apr. 27, 1921.]

The thunderstorm is one of the greatest obstacles to routine flying during the summer months. At an aviation station it is important, therefore, to know the approximate time of arrival of thunderstorms, their extent and duration. Unless these things are known, air craft may be caught away from shelter or safe landing place, and may be forced to land where they will be unable to return to their base for hours or days; or, worse still, conditions dangerous to craft and personnel may be encountered. If, on days when thunderstorm conditions prevail, the alternative is taken and flying is suspended in anticipation of thunderstorms which do not arrive for many hours or perhaps not at all, much valuable flying time is lost.

During the summer of 1920, in order to test the value of atmospheric static electricity as an indication of thunderstorms and an aid in forecasting these storms for flying operations, a radiotelegraph receiving set was installed in the aerological office, Naval Air Station, Hampton Roads, Va. The set consisted of a six-step amplifier (type SC 1605B used in Navy seaplanes) with a variable condenser and head phones. The antenna was a Navy standard bidirectional compass coil (type SE 4080). The choice of wave length ranged approximately from 600 to 2,500 meters.

Hourly observations were made each day between 8 a. m. and 4 p. m., with the exception of Saturday afternoon and Sunday. Frequently intermediate observations were made. Data were logged according to the following classification:

(*a*) Hour of observation.

(*b*) Wave length on which "strays" were most intense.

(*c*) Quality of "strays," whether "whip cracks," "grinders," or combination of these.

(*d*) Intensity of "strays" whether faint, moderate, strong, or deafening.

(*e*) Number of "strays," i. e., whether continuous or intermittent. If intermittent, give number per minute.

(*f*) Directional plane to eight points in which "strays" were strongest, i. e., whether they appeared to lie in the north-south plane, the east-west plane, the northwest-southeast plane, or the northeast-southwest plane.

(*g*) Change in intensity since last observation, whether increasing or decreasing.

(*h*) Amount, azimuth, and size (small, medium, or towering) of any cumulo-nimbus clouds within sight of station.

The following are some averages computed from the total observations:

Average wave length on which best results were obtained, 900 meters.

Average intensity of "strays" on days when no thunderstorms were reported at or near station (based on scale of zero to four), 1.4.

Average intensity of "strays" on days when thunderstorms were reported at or near station, 1.9.

Per cent by which intensity on thunderstorm days exceeded intensity on no thunderstorm days, 36 per cent.

"Strays" seemed to lie most frequently in the northwest-southeast plane (their direction was probably northwest).

The next most frequent plane was southwest-northeast.

From the experience of last summer it is believed that the "static" recorder is a valuable instrument for aerological stations. The above averages minimize rather than magnify the actual usefulness of a "static" indicator in forecasting for aviation. It must be remembered that this attempt was the first of its kind at this station, and that the apparatus used was designed for radiotelegraphy, not for detection of "static" for meteorological purposes. Since under these conditions the "static" log was found of considerable value in forecasting thunderstorms in the vicinity of the air station,

[5] Beals, Edward Alden: The value of weather forecasts in the problem of protecting forests from fire. MO. WEATHER REV., February, 1914, 42: 111-119.

[6] See next REVIEW.

it is expected to be of more use during the coming summer. A recording instrument is to be installed to keep a continuous record of the intensity of "static" and a direction-recording instrument also is being devised. With these used in connection with the daily weather map and local meteorological data it is hoped to forecast with considerable accuracy the approximate time, extent, and duration of thunderstorms occurring within 20 or 30 miles of the air station.

NAVAL METEOROLOGY DURING SEAPLANE FLIGHTS FROM SAN DIEGO TO BALBOA.

By J. C. O'BRIEN, C. Q. M. (M.), United States Navy.

[U. S. S. *Aroostook*, Pacific Fleet, April, 1921.]

The following few paragraphs contain a brief sketch of the conditions of the weather and forecasting results obtained by the United States Navy meteorologists during the trip to and from Balboa, Panama.

Aside from what data can be obtained from the hydrographic pilot charts there is to be found very little information of value in regard to weather conditions from San Diego, Calif., to Balboa, Canal Zone.

The daily forecasts issued by the aerological department aboard the flagship U. S. S. *Aroostook* during the long flight of the seaplanes from San Diego, Calif., to Balboa, while compiled from a limited amount of data, and entirely without the use of a weather map, showed a remarkable percentage of correct conditions encountered during the trip both to and from Balboa, Panama.

The most valuable means of forecasting were obtained by the use of the barometer, thermometer, and hydrograph, together with a continual study of the clouds and appearance of the sky. A nephoscope was used to advantage in the cloud study.

The two most treacherous places for which to forecast along the coast were the Gulfs of Fonseca and Tehauntepec. It is in the latter of these that unusually strong winds prevail for days at a time, almost without apparent cause, and a barometer gives no indication of the intensity of these wind streams. In lieu of the practically infallible weather maps it was found necessary to partly rely upon old Mexican Indian weather lore, covering the wind that is known locally as a "Tehauntepecker."

These winds, beginning about the middle of October, continue to prevail until April when they die out, and are then supplemented by the prevailing south-southwest wind for the following months of June, July, and August.

The "Tehauntepecker" is a northerly wind which may vary a few points to either east or west of true north. It blows with considerable violence and is noticeable several hundred miles out to sea. The highest velocity recorded was 48 miles an hour as shown by the anemometer. This causes a short, high sea, which makes the handling of seaplanes not only difficult but dangerous.

The use of pilot balloon soundings at sea were attempted during this trip, but owing to the continuous motion of the ship and the heavy smoke from its stacks it was impossible to obtain any satisfactory results in this way.

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WEATHER AT GENEVA DURING THE WINTER 1920-21.

[Reprinted from the *Journal de Geneve*, Mar. 29, 1921.]

(Translated by Lewis W. Haskell, American consul, Geneva, Switzerland, Mar. 29, 1921.)

The most characteristic feature of the winter 1920–21 is unquestionably its *dryness.*

As to the temperature, the winter has been normal but rather warm. It was not as normal, nor so warm, however, as the preceding winter. Last year, the three winter months of December, January, and February had almost the same temperature. This year, they were all warm, but unequally so; and the month of January, which should be the coldest, was much warmer than the other months. It may even be said that it was, after January, 1834, the warmest month of January in our series. Every day of the month has been in excess of the average temperature and none was under 0° C.. The coldest day, January 7, with 0.01°, was still 0.33° above the average temperature. This is extremely rare, especially in winter. The month of January, 1834, had a mean temperature of 5.14°; the year 1834 was in fact a quite exceptional year, with 11.48°.

If we now consider the precipitation of the winter, we may see that the winter 1920-21, as well as the preceding one, has been almost without snow; 4 centimeters on December 16, 3 centimeters on January 17, and 4 centimeters on February 2; 11 centimeters in all.

The winter season has been dry, but less so than we think. It has even rained rather often, especially in December and in January; but never in large amounts; the greatest amounts were 13 millimeters on December 3; 18 millimeters on January 13, and 9 millimeters on February 2.

We must not forget that if the actual winter seems to us to be very dry, it is because we compare it with the immediately preceding winters. During the last 25 years the winters have been characterized by much greater precipitation than for the 70 years preceding these 25 years:

Period from 1826 to 1895, 138 millimeters per winter.

Period from 1896 to 1920, 186 millimeters per winter.

There has then been a mean augmentation of almost 50 millimeters, which is very great, and this fact explains our opinion that a winter season with only 87 millimeters is a very dry winter after the very wet winters which have so long prevailed.

But the most characteristic feature of this last winter is that the dryness began in the autumn—September, 1920, with 182 millimeters; but October, with 65 millimeters, and especially November, with 12 millimeters, were under normal. This explains the actual dryness, because from September to February, there should have fallen, according to the average quantity for 95 years, 327 millimeters of rain, and the quantity has been only 164 millimeters—that is to say, exactly half of the ordinary quantity.

There have been, in the past, periods of these same five months which were also dry. We give them here below, the last years being given first:

Winter.	Amount of rain (in millimeters).		Total.	Temperature of the winter.
	October, November, and December.	February and March.		
1920-21	77	87	164	Warm.
1908-9	61	89	150	Cold.
1904-5	51	88	139	Normal (cool).
1897-98	15	121	136	Rather warm.
1890-91	125	44	169	Very cold.
1879-80	108	87	195	Do.
1873-74	149	37	186	Normal.
1869-70	97	101	198	Rather cool.
1867-68	97	61	158	Normal.
1863-64	78	56	134	Cold.
1853-54	123	42	165	Do.